

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

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A-1 1. (Currently Amended) An image processing computer system for a photogrammetric analytical measurement[[,]] ~~using in which camera parameters necessary for production of a survey map are determined based on a picture having an image of a target, said camera parameters representing a photographing position and a photographing direction of a camera, by which said picture is photographed,~~ the target having at least three main reference point areas and at least one assistant reference point area, each of the main and assistant reference point areas being ~~formed as~~ a high luminance point area surrounded by a low luminance area, said computer system comprising:

a target-image extractor that extracts the image of ~~said~~ the target from ~~said~~ the picture, ~~by detecting high luminance point areas, each corresponding to one of based on positional relationships between~~ the main and assistant reference point areas of ~~said~~ the target;

an image processor that processes the extracted image of ~~said~~ the target to determine a two-dimensional position of each of ~~said~~ the main and assistant reference point areas of ~~said~~ the target with respect to a two-dimensional picture coordinate system defined on ~~said~~ the image;

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a first calculator that calculates three-dimensional positions of ~~said~~ the main reference point areas with respect to a three-dimensional camera coordinate system defined on ~~said~~ a camera that photographs the picture;

a second calculator that calculates two-dimensional positions of ~~said~~ the main reference point areas with respect to a two-dimensional image-plane coordinate system, defined on an image plane of ~~said~~ the camera, based on the three-dimensional positions of ~~said~~ the main reference point areas calculated by said first calculator; and

A1 a third calculator that calculates camera parameters based on the two-dimensional positions of ~~said~~ the main reference point areas with respect to ~~said~~ the two-dimensional picture coordinate system and the two-dimensional positions of ~~said~~ the main reference point areas with respect to ~~said~~ the two-dimensional image-plane coordinate system, the camera parameters including a position and a direction of the camera when the picture is photographed.

2. (Currently Amended) ~~An~~ The image processing computer system as set forth in claim 1, further comprising:

a fourth calculator that calculates a three-dimensional position of ~~said~~ the assistant reference point area with respect to ~~said~~ the three-dimensional camera coordinate system based on the camera parameters calculated by said third calculator;

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a fifth calculator that calculates a two-dimensional position of ~~said~~ the assistant reference point area with respect to ~~said~~ the two-dimensional image-plane coordinate system based on the three-dimensional position of ~~said~~ the assistant reference point area calculated by said fourth calculator; and

41 a determiner that determines whether ~~the calculation of~~ the camera parameters calculated by said third calculator is are correct ~~or incorrect~~ by comparing the two-dimensional position of the assistant reference point area obtained by said image processor with the two-dimensional position of ~~said~~ the assistant reference point area calculated by said fifth calculator.

3. (Currently Amended) An image processing method for a photogrammetric analytical measurement[[,]] using ~~in which camera parameters necessary for production of a survey map are determined based on a picture having an image of a target, said camera parameters representing a photographing position and a photographing direction of a camera, by which said picture is photographed,~~ the target having at least three main reference point areas and at least one assistant reference point area, each of the main and assistant reference point areas being ~~formed~~ as a high luminance point area surrounded by a low luminance area, said method comprising ~~steps of:~~

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extracting the image of ~~said~~ the target from ~~said~~ the picture, by detecting high luminance point areas, each corresponding to one of ~~based on positional relationships between~~ the main and assistant reference point areas of ~~said~~ the target;

processing the extracted image of ~~said~~ the target to determine a two-dimensional position of each of ~~said~~ the main and assistant reference point areas of ~~said~~ the target with respect to a two-dimensional picture coordinate system defined on ~~said target~~ the image;

calculating three-dimensional positions of ~~said~~ the main reference point areas with respect to a three-dimensional camera coordinate system defined on ~~said a camera~~ that photographs the picture;

calculating two-dimensional positions of ~~said~~ the main reference point areas with respect to a two-dimensional image-plane coordinate system, defined on an image plane of ~~said~~ the camera, based on the three-dimensional positions of ~~said~~ the main reference point areas; and

calculating camera parameters based on the two-dimensional positions of ~~said~~ the main reference point areas with respect to ~~said~~ the two-dimensional picture coordinate system and the two-dimensional positions of ~~said~~ the main reference point areas with respect to ~~said~~ the two-dimensional image-plane coordinate system, the camera parameters including a position and a direction of the camera when the picture is photographed.

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4. (Currently Amended) ~~An~~ The image processing method as set forth in claim 3, further comprising:

calculating a three-dimensional position of ~~said~~ the assistant reference point area with respect to ~~said~~ the three-dimensional camera coordinate system based on the calculated camera parameters;

calculating a two-dimensional position of ~~said~~ the assistant reference point area with respect to ~~said~~ the two-dimensional image-plane coordinate system based on the calculated three-dimensional position of ~~said~~ the assistant reference point area; and

41 determining whether ~~the calculation of~~ the camera parameters is are correct or incorrect by comparing the two-dimensional position ~~based on said~~ of the assistant reference point area with respect to the two-dimensional picture coordinate system with the two-dimensional position of ~~said~~ the assistant reference point area ~~based on said~~ with respect to the two-dimensional image-plane coordinate system.

5. (Currently Amended) A memory medium storing an image processing program for a photogrammetric analytical measurement[[,]] using ~~in which camera parameters necessary for production of a survey map are determined based on a picture having an image of a target, said camera parameters representing a photographing position and a photographing direction of a camera, by which said picture is photographed; the target having~~

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at least three main reference point areas and at least one assistant reference point area, each of the main and assistant reference point areas being ~~formed as~~ a high luminance point area surrounded by a low luminance area, said program comprising ~~steps of~~:

extracting the image of ~~said the~~ target from ~~said the~~ picture, by detecting high luminance point areas, each corresponding to one of ~~based on positional relationships between~~ the main and assistant reference point areas of ~~said the~~ target;

processing the extracted image of ~~said the~~ target to determine a two-dimensional position of each of ~~said the~~ main and assistant reference point areas of ~~said the~~ target with respect to a two-dimensional picture coordinate system defined on ~~said target~~ the image;

calculating three-dimensional positions of ~~said the~~ main reference point areas with respect to a three-dimensional camera coordinate system defined on ~~said a camera that~~ photographs the picture;

calculating two-dimensional positions of ~~said the~~ main reference point areas with respect to a two-dimensional image-plane coordinate system, defined on an image plane of ~~said the~~ camera, based on the three-dimensional positions of ~~said the~~ main reference point areas; and

calculating camera parameters based on the two-dimensional positions of ~~said the~~ main reference point areas with respect to ~~said the~~ two-dimensional picture coordinate system and the two-dimensional positions of ~~said the~~ main reference point areas with respect to ~~said~~

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the two-dimensional image-plane coordinate system, the camera parameters including a position and a direction of the camera when the picture is photographed.

6. (Currently Amended) A The memory medium as set forth in claims 5, wherein said program further comprises:

calculating a three-dimensional position of ~~said~~ the assistant reference point area with respect to ~~said~~ the three-dimensional camera coordinate system based on the calculated camera parameters;

calculating a two-dimensional position of ~~said~~ the assistant reference point area with respect to ~~said~~ the two-dimensional image-plane coordinate system based on the calculated three-dimensional position of ~~said~~ the assistant reference point area; and

determining whether ~~the calculation of~~ the camera parameters ~~is~~ are correct ~~or incorrect~~ by comparing the two-dimensional position ~~based on said~~ of the assistant reference point area with respect to the two-dimensional picture coordinate system with the two-dimensional position of ~~said~~ the assistant reference point area ~~based on said~~ with respect to the two-dimensional image-plane coordinate system.

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